



Guidelines for Quantifying and Evaluating Wood Decay

in Stems and Branches.

Bruce R. Fraedrich, Ph. D., Plant Pathologist

Introduction

Decay is a leading factor that predisposes branches and stems to failure. The size of the decay column relative to the diameter of the branch or stem can be an important determination to assist in assessing whether a stem or branch poses a severe risk of failure. This Technical Report provides guidelines for measuring and evaluating decay in stems and branches to help assess failure potential.

Measurements

Visually assess stem and crown to determine weakest area due to decay. In some instances, several sites on the stem and/or branch may require evaluation.

Measure stem/branch diameter (**D**) at weakest point. Subtract twice the bark thickness to obtain the wood diameter at the defect. If a cavity opening is present, then measure width of opening (**W**). Multiply stem/branch diameter (**D**) by 3.14 to obtain circumference (**C**) at weakest point (**C=D X 3.14**). Determine the percentage of the circumference with cavity opening by dividing the width of the opening (**W**) by circumference (**C**) and multiplying by 100 (**% Cavity Opening = W/C X 100**).

Calculate the average thickness of sound wood surrounding the defect by probing with a 1/8" drill bit (with long flute) and battery operated drill. Drill into sound wood until resistance

D = Stem Diameter

C = Circumference = D X 3.14

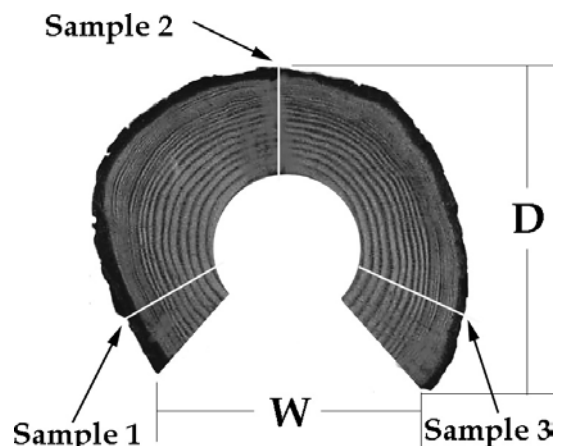
W = Width of Cavity Opening

% Cavity Opening = $\frac{W}{C} \times 100$

**Average Thickness of Sound Wood =
Depth to Decay: Sample 1+2+3**

3 *

* Number of Sample Sites



significantly decreases, when decay is encountered. Extract drill bit and measure depth to decay. Subtract bark thickness from measurement. Sample a minimum of three sites on all stem/branches with an additional site per 10 inches of wood diameter. Increase sampling when sample depths vary greatly. A Resistograph or an increment borer can be used in lieu of the drill and drill bit.

Add together the sample values and divide by the number of sample sites to obtain an average thickness of sound wood surrounding the defect.

Thresholds

Refer to **Table 1** for the minimum thickness of sound wood surrounding decay columns with and without cavity openings. Corresponding to the size of the cavity opening (left column), multiply the stem/branch diameter by the fraction in the right hand column to obtain the average minimum thickness of sound wood to support the stem or branch. **If the actual** minimum thickness is less than that value, then the stem/branch probably represents a high risk of failure.

Table 1. Minimum thickness of sound wood surrounding decay columns on stems and branches with and without cavity openings.

Cavity opening % of circumference	Minimum Thickness of Sound Wood Surrounding Decay (Wood Diameter X)	
	High Risk	Critical Risk
0	0.15	0.10
5%	0.17	0.11
10%	0.18	0.12
15%	0.20	0.14
20%	0.23	0.15
25%	0.26	0.17
30%	0.33	0.18

Many factors interact with decay to cause failure of stems and branches. In many instances such as when multiple defect are present, species wood characteristics are weak or prone to failure or decay is present at stress points, the thickness of sound

- Leaning stems/branches
- Trees with unbalanced crowns or low crown ratios
- Trees with multiple defects
- Decay present at a stress point (such as mid-crown region of stem, bend in stem or limb, decay in reaction wood)
- Tree species with weak or brittle wood characteristics (including red

wood surrounding the decay column must be greater than the minimum specified in Table 1. The minimum thickness of sound wood should be increased in the following instances:

- maple, silver maple, poplar, tulip poplar, linden, horsechestnut, and cottonwood)
- Stem/branch with asymmetrical decay columns
- Trees with declining vitality
- Trees in highly exposed locations
- Sensitive target locations / high use site



Figure 1. Graphic representation showing minimum thickness of sound wood for decayed stems/branches with and without cavity openings (For Severe Risk).

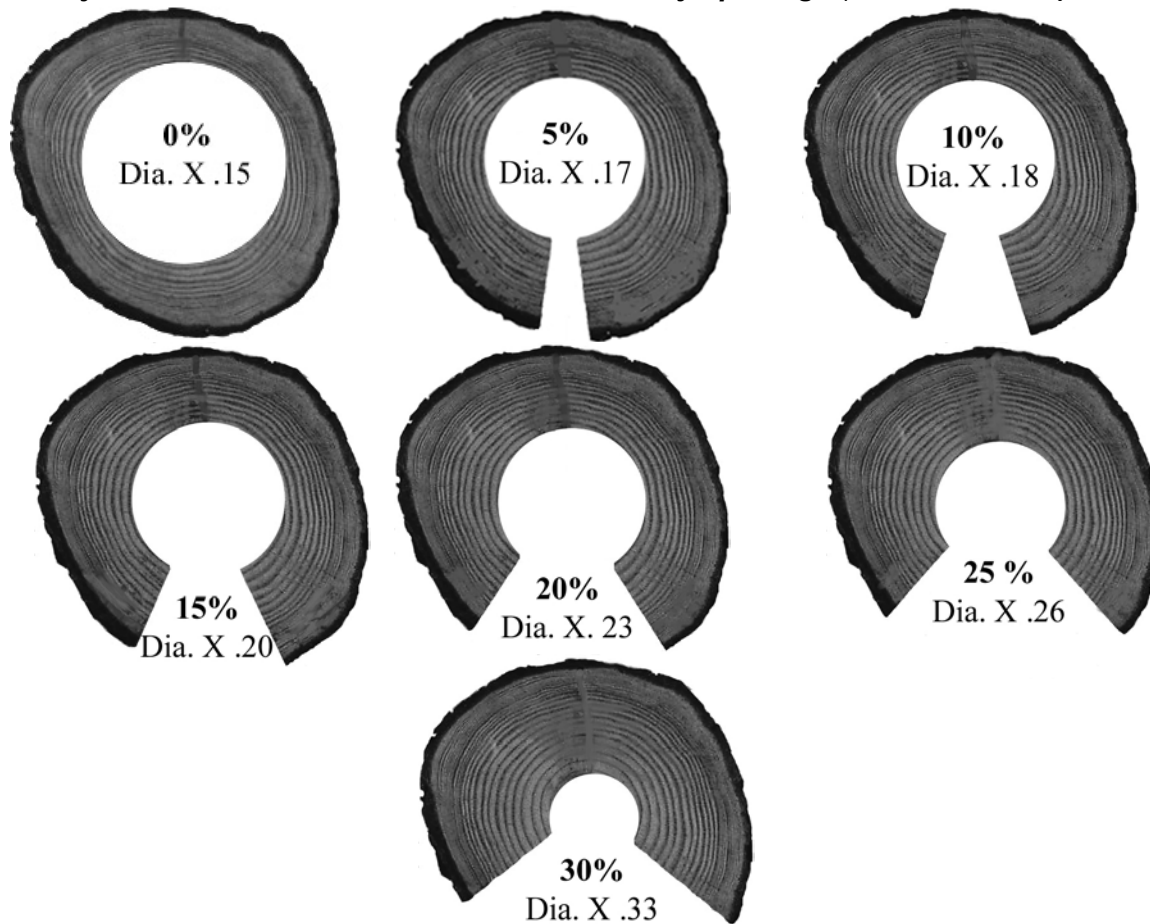


Table 2. Minimum average thickness of sound wood surrounding decay columns with and without cavity opening to be considered a **severe** defect.

Stem Diameter	Cavity Opening% Circumference						
	0	5	10	15	20	25	30
	<i>(Minimum Thickness (inches) of sound wood)</i>						
10	1.5	1.7	1.8	2	2.3	2.6	3
15	2.25	2.55	2.7	3	3.45	3.9	4.5
20	3	3.4	3.6	4	4.6	5.2	6
25	3.75	4.25	4.5	5	5.75	6.5	7.5
30	4.5	5.1	5.4	6	6.9	7.8	9
35	5.25	5.95	6.3	7	8.05	9.1	10.5
40	6	6.8	7.2	8	9.2	10.4	12
45	6.75	7.65	8.1	9	10.35	11.7	13.5
50	7.5	8.5	9	10	11.5	13	15
55	8.25	9.35	9.9	11	12.65	14.3	16.5
60	9	10.2	10.8	12	13.8	15.6	18